

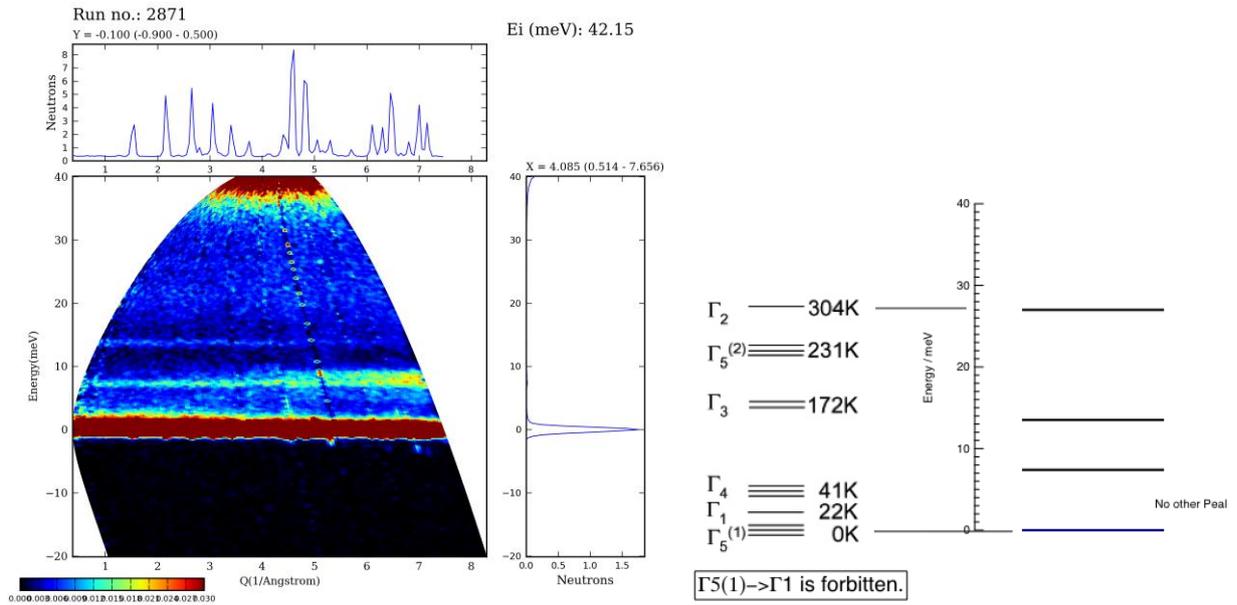
 <b>MLF Experimental Report</b>	提出日 Date of Report 2013.3.3
課題番号 Project No. 2012B0214  実験課題名 Title of experiment Determination of crystalline electrical field level of strongly correlated electron systems: $\text{Yb}_{1-x}\text{Tm}_x\text{B}_6$ and $\text{TmB}_4$ 実験責任者名 Name of principal investigator Fumitoshi Iga 所属 Affiliation Ibaraki University	装置責任者 Name of responsible person Kenji Nakajima 装置名 Name of Instrument/(BL No.) AMATERAS/(BL.14) 実施日 Date of Experiment 2012/Dec/1-2012/Dec/5

試料、実験方法、利用の結果得られた主なデータ、考察、結論等を、記述して下さい。(適宜、図表添付のこと)  
 Please report your samples, experimental method and results, discussion and conclusions. Please add figures and tables for better explanation.

1. 試料 Name of sample(s) and chemical formula, or compositions including physical form.
<p><math>\text{Yb}_{1-x}\text{Tm}_x\text{B}_6</math> (<math>x = 0.35</math>)  <math>a = b = c = 4.11</math> Angstrom, <math>\alpha = \beta = \gamma = 90</math> degree. CsCl-type simple cubic structure (Space Group:Pm3m)</p> <p><math>\text{TmB}_4</math>  <math>a = b = 7.01</math> Angstrom, <math>c = 4.01</math> Angstrom, <math>\alpha = \beta = \gamma = 90</math> degree, <math>\text{UB}_4</math>-type tetragonal structure (SG: P4/mbm)</p> <p>powder samples, harmless, every volume = 3 cc, 8 gram They were encapsulated by using of aluminum foil.</p>

2. 実験方法及び結果 (実験がうまくいかなかった場合、その理由を記述してください。) Experimental method and results. If you failed to conduct experiment as planned, please describe reasons.
<p>Experimental method and results: Inelastic neutron scattering                  4 kinds of incident energy: 1.688, 3.137, 7.746, and 40 meV                  Temperature: 6-8K, 50K, 100K                  Scanning of scattering wave vector : <math>Q=0.25 - 1.25 \text{ \AA}^{-1}</math>, <math>1.25 - 2 \text{ \AA}^{-1}</math>, etc.</p> <p>(1) <math>\text{Yb}_{1-x}\text{Tm}_x\text{B}_6</math> (<math>x=0.35</math>)                  Some magnetic peaks observed in this system were positioned at the almost same energy compared to the previous experiment for <math>x = 0.46</math>. Expected peaks from the calculated crystal field level splitting were not observed in energy region lower than 10 meV. This means that CEF calculation is right in energy higher than 10 meV but not so in lower one. In such a case, quasi elastic peak should be observed at around zero energy if Kondo effect expected in this trivalent Tm ion is appeared. But even QE peak was not observed in 1 meV scale. We have to investigate the another concentration , such as <math>x = 0.05</math> to <math>0.20</math>, in later period.</p>

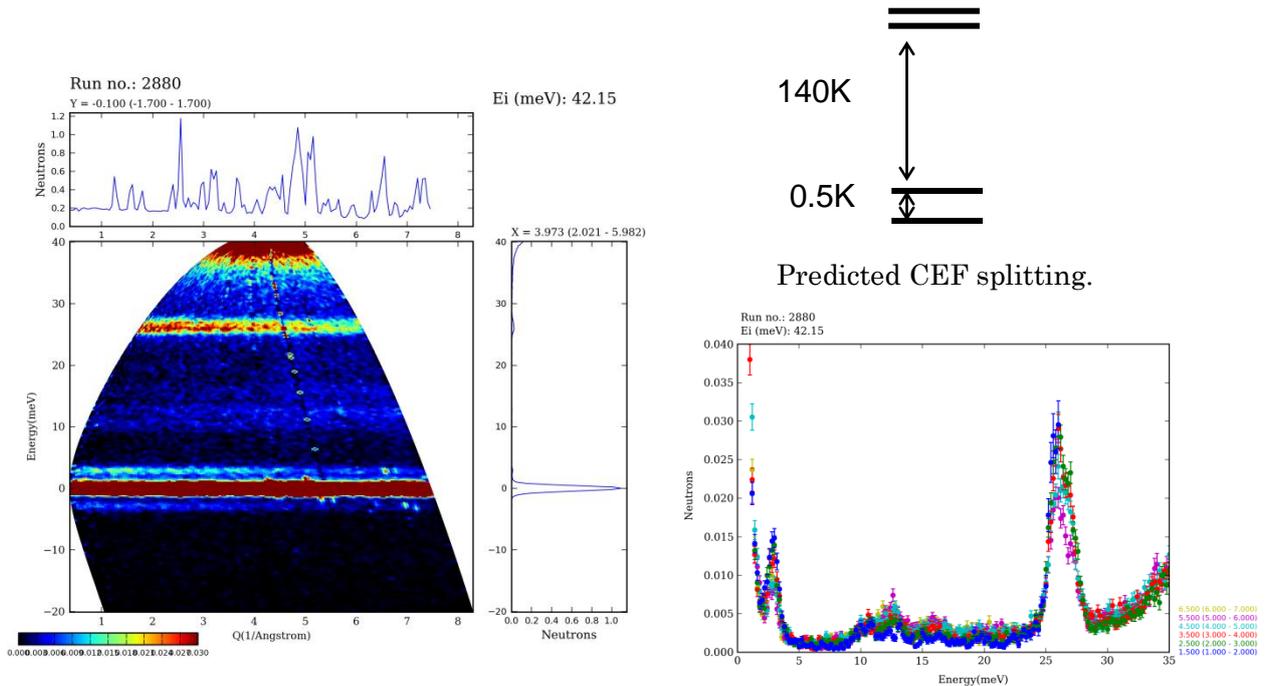
## 2. 実験方法及び結果(つづき) Experimental method and results (continued)



Inelastic neutron result on  $\text{Yb}_{0.65}\text{Tm}_{0.35}\text{B}_6$  at  $T = 6 \text{ K}$ . Left side is CEF calculation and right side is exp. data.

### (2) $\text{TmB}_4$

$\text{TmB}_4$  is expected to show magnetic frustration effect. Magnetic susceptibility and heat capacity were calculated by the molecular field approximation method using the 2nd  $B^2$  and 4th  $B^4$  terms. Observed CEF excitation peaks were fully fit to the expected CEF level scheme. This result would support our analysis on  $\text{TmB}_4$ .



Observed spectra. The excitation at 10-15 meV is consistent with the result of CEF calculation.